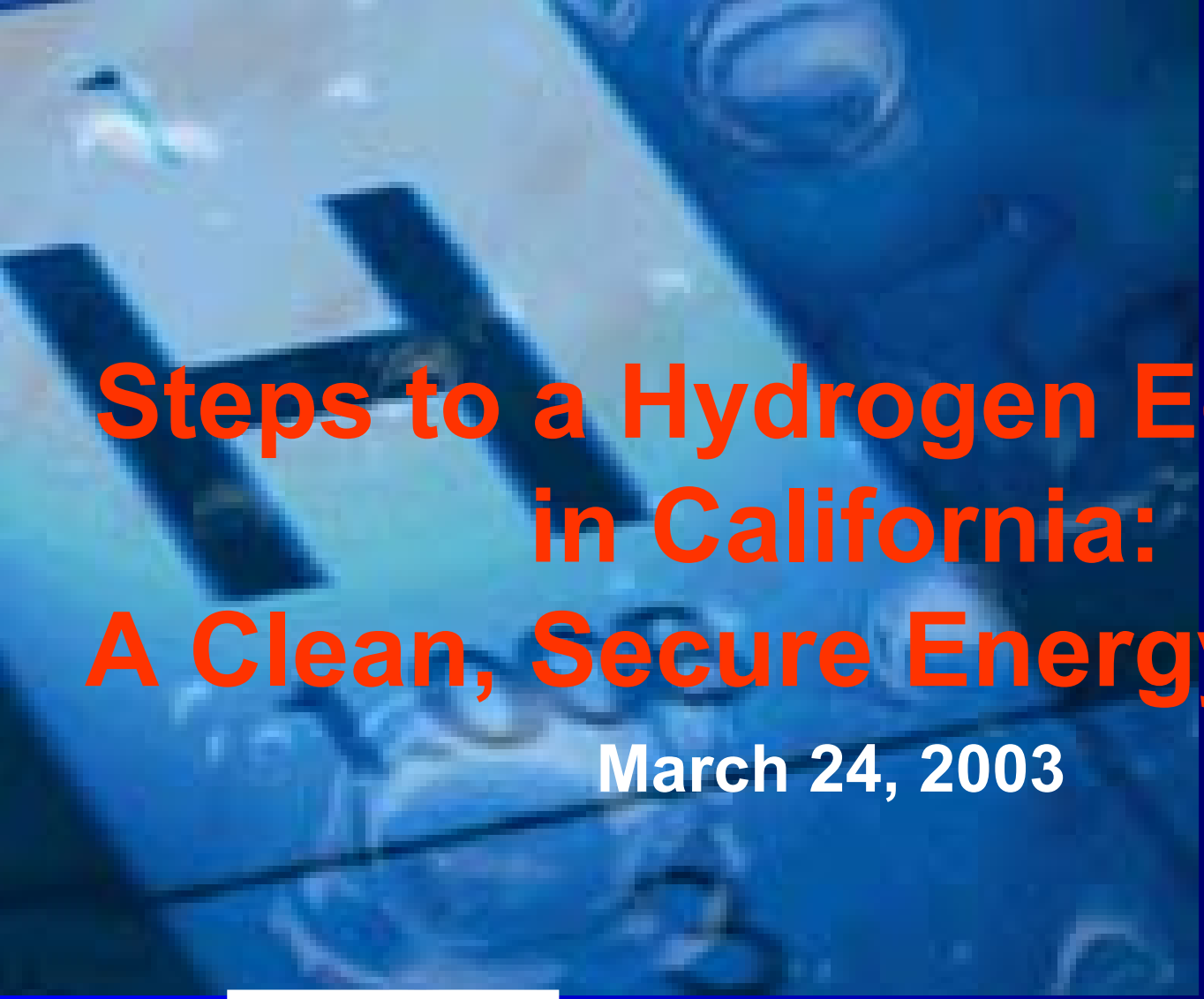


Steps to a Hydrogen Economy in California: A Clean, Secure Energy Future

March 24, 2003

WELCOME!

- DO's and DON'Ts:
  - DO
    - **turn off your phone and pager**
    - **feel free to think creatively**
    - **participate**
    - **be respectful of others ideas**
  - DON'T
    - **wear a tie**
    - **wear a title**

Challenge the Map Maker

Overarching Question

What should the State of California do to meet its energy needs and halt the rise of human-induced pollution and greenhouse gas emissions?

Goal for the Day

Prioritize driving forces and identify as well as address primary challenges for California to achieve a clean, secure energy future and develop the first steps to get there.

Agenda
(from here on)

10:20 a.m. Hydrogen NOW! David Freeman

10:30 Why should California accelerate the commercialization of hydrogen? Jim Boyd

Facilitated discussions

11:15 Step 1: Let's look at Scenarios for California in 2050

12:00 Break (pick up lunch and return)

12:15 Step 2: Let's assess where we are now…

12:45 Step 3: What is our State strategy to facilitate the commercialization of H2?

2:00 Break

2:15 Let's Go!

3:00 Adjourn

Hydrogen NOW!

Comments from David Freeman

Why should California accelerate the commercialization of Hydrogen?

Jim Boyd, CEC

Step 1: Let's look at California in 2050

Shannon Baxter, ARB

Source:
Energy Needs, Choices and Possibilities: Scenarios to 2050. Global Business Environment, Shell International, 2001.

Fundamental Challenges for World

- giving all people access to efficient, commercial energy
- meet the expanding and shifting energy needs of an urbanizing world
- preventing pollution which damages health, blights environments and threatens vital natural systems

Driving Forces

- Energy Resource Scarcity (causes disruptions in power, affects cost)
- New Technologies (can offer superior/new qualities that may off-set higher cost)
- Social and Personal Priorities

Consumers will pay a premium for superior attributes

- **Oil was twice the price of coal when its efficiency, convenience and cleanliness drove a transition from coal (using ICE).**
- **Natural gas is preferred for heating because it is convenient, not the most inexpensive fuel choice.**

Wealthy societies debate priorities, not absolute affordability

Two Scenarios

- Dynamics as Usual
  - Driving force: Social and Societal Priorities
    Government pushes energy systems on behalf of citizens concerned with common good (energy security and environment)
- *The Spirit of the Coming Age*
  - Driving force: New Technologies
    Consumer Demand pulls clean, convenient and flexible energy services

Source:

Energy Needs, Choices and Possibilities: Scenarios to 2050.
Global Business Environment, Shell International, 2001.

Scenario 1: Dynamics as Usual

- **2005** Hybrid Vehicles proliferate with ARB pushes
- **2010** "Dash for Gas"; Renewable pump priming
- **2020** US renewables stall at 20% of electricity supply; Gas security concerns emerge
- **2030** New nuclear stalls; Next generation of renewables emerges
- **2040** Oil scarcity drives biofuels expansion

- 2050 1/3 of world's energy is from renewables

Scenario 2: *The Spirit of the Coming Age*

- **2005** 1st stationary and vehicular fuel cells; high consumer interest
- **2010** Gas resource outlook expands; fuel cell fuel distribution innovations; renewables limited to niches
- **2015** Convergence around fuel cells for transport and stationary uses--gas network backbone
- **2020** Unconventional oil & gas expand in China and India; fuel cells reach 25% sales in US
- **2030** Solid H2 storage transition; renewables pulled by strong H2 demand
- **2040** H2 infrastructure expansion

Government Role

- Continue to pursue energy efficiency goals (policies encourage cleaner power plants and vehicles)
- Support renewable technologies based on societal priorities
- Education of consumers
- Continue high risk R&D (i.e. nanotechnology, biotechnology)
- Technology transfer to developing countries (i.e. China, India)

Scenario Results

Dynamics as Usual

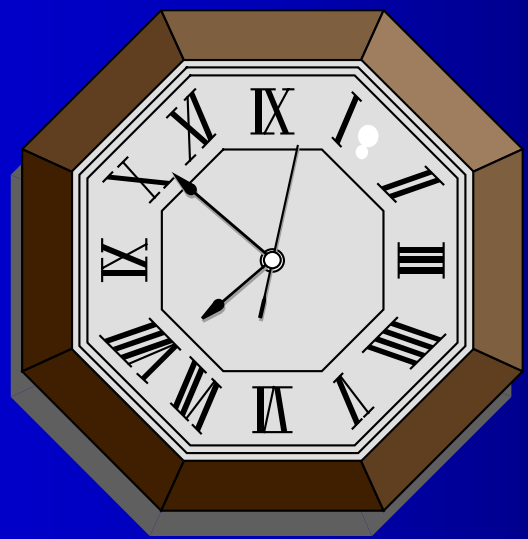
- Resource scarcity of oil leads to energy efficiency measures off-set expanding energy needs of world until 2010 when natural gas starts gaining prominence
- Renewables gain prominence after advances in energy storage
- Renewables gain a 1/3 world wide share

The Spirit of the Coming Age

- New technology (fuel cells) offer superior/new qualities that off-set higher cost
- Fuel cells are initially successful due to convenience of "box of fuel"
- Large scale renewable production of electricity is used to produce hydrogen from electrolysis
- Developing countries "leap frog" to FCs and H2

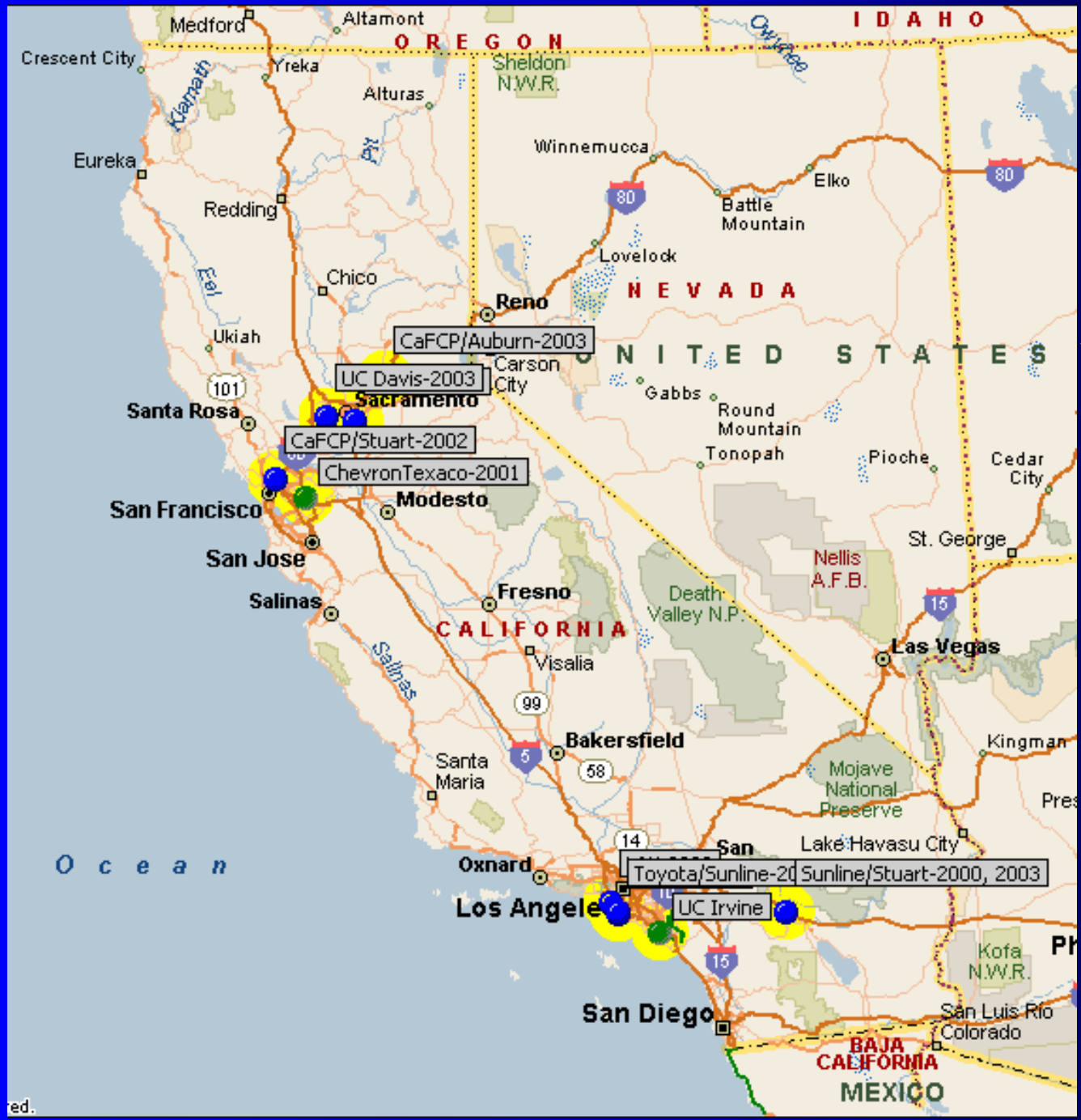
What are the top two most important things that need to be accomplished in order to bring a clean, secure energy future to California?

15 minute break to pick up lunch (delivered)
and
return for working lunch



Step 2: Assess where California is in 2003

Moderator: Alan Lloyd



A Map of Hydrogen Activities in California, 2003

What would you say is the primary reason that these projects are located in CA?

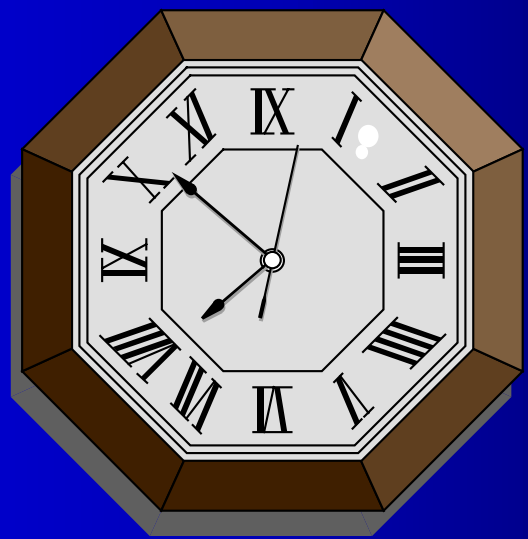
- Intellectual resources
- State encouragement
- Climate
- Other

Step 3: Can we see a common vision for a State strategy?

Moderator: Woody Clark

How can we address the challenges identified in Step 1?

15 minute break



Step 4: Let's GO!

(Develop a 6 month strategy that starts today)

Moderator: Devinder Garewal

Adjourn

www.arb.ca.gov/msprog/hydrogen/hydrogen.htm